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One thousand ways to experience loss: A systematic analysis of climate-related intangible harm from around the world

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ABSTRACT

A situated and socially engaged science of loss arising from climate change takes people's lived experiences with risk and harm as its fundamental starting point. It foregrounds what losses occur, where and how, which of these losses matter most to people and why, and whether or not such losses are considered acceptable and potentially reversible. However, obtaining such insight is difficult if the many things people value, across space and time, are intangible, i.e. they cannot and perhaps should not be quantified, and hence are often overlooked and omitted. This is the case, for instance, for the symbolic and affective dimensions of culture and place, such as sense of belonging, personal and collective notions of identity, and ways of knowing and making sense of the world, all of which are already undermined by climate change. Here, we perform the first systematic comparative analysis of people-centered and place-specific experiences with climate-related harm to people's values that are largely intangible and non-commensurable. We draw upon > 100 published case studies from around the world to make visible and concrete what matters most to people and what is at stake in the context of climate-related hazards and impacts. We show that the same threats can produce vastly different outcomes, ranging from reversible damages to irreversible losses and anticipated future risks, across numerous value dimensions, for indigenous and non-indigenous families, communities, and countries at all levels of development. Through this analysis, we also empirically validate dimensions of harm that have been produced and reproduced in the literature, albeit often devoid of distinct substance, lived experiences, and intrinsic significance. We end by discussing ethical implications of the 'one thousand ways' to encounter harm and offer recommendations to overcome methodological challenges in advancing a science of loss grounded in place.

1. Introduction

Scholarly and policy interest in losses resulting from climate change that are intangible or not captured by market evaluation ('non-economic') has grown substantially over the last five years (e.g. Alston et al., 2018; Barnett et al., 2016; Preston, 2017; Roberts and Pelling, 2018; Serdeczny et al., 2016, 2018; Tschakert et al., 2017). This is due, on the one hand, to increased scientific understandings of and concerns about the limits to climate change adaptation, even under relatively modest levels of warming and risks of attendant losses (e.g. Barnett et al., 2015; Dow et al., 2013; Roberts and Pelling, 2018; Thomas and Benjamin, 2017; Mechler et al., 2018). On the other hand, heightened attention to loss now pervades international climate negotiations, formalized through the Warsaw International Mechanism (WIM) on Loss and Damage[1] (L&D) under the United Nations Framework Convention on Climate Change (UNFCCC). The WIM established L&D as a 'third pillar' of climate policy, alongside mitigation and adaptation (see Roberts and Pelling, 2018; Serdeczny et al., 2016), with non-economic losses explicitly included. The 2015 Paris Agreement (Article 8) recognizes "the importance of averting, minimizing and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events, and the role of sustainable development in reducing the risk of loss and damage" (UNFCCC, 2015, p. 12). Hence, L&D has become a significant topic for international climate negotiations and research (Boyd et al., 2017; Mechler and Schinko, 2016; Page and Heyward, 2017).

Scholarship on intangible, non-economic/non-market loss and damage has come a long way in a short period of time. Initial efforts focused on what to count under such 'residual' climate impacts and how to best measure them. Various typologies were proposed to distinguish between material and immaterial, economic and non-economic losses and damages (Morrissey and Oliver-Smith, 2013), losses to private

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[1] Loss and Damage' (L&D) refers to the policy framework whereas 'loss and damage' denotes the broader area of scholarship on the topic.

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individuals, society and the environment (Fankhauser et al., 2014), and to intrinsic and instrumental values (Serdeczny et al., 2016), amongst others (see also Andrei et al., 2015). Yet, these attempts lack empirical substantiation, often relying upon a limited number of illustrative case examples, if any. Quantitative approaches to measuring and reporting non-economic loss, albeit useful for expert analyses of trade-offs in adaptation choices or risk assessments (Fankhauser et al., 2014), are often at odds with the lived and felt realities of harm. While offering a common language in negotiations, prioritizing what is quantifiable and in the interests of governments and nation states, these metrics obfuscate non-quantifiable dimensions of harm that are no less significant to people within their own contexts (McShane, 2017; Preston, 2017). McShane (2017) argues that this bias not only renders lived and embodied losses 'invisible' to decision-makers, their invisibility also constitutes a potential injustice. Such injustice is compounded when quantitative accounts of loss are further aggregated, e.g. for comparisons, and value judgements are made by experts far removed from the existential experiences of loss (Preston, 2017; Serdeczny et al., 2018; Tschakert et al., 2017).

A situated and socially engaged science of loss puts people and their experiences at the center of analysis, in an attempt to counter the material and discursive erasures evident in quantified top-down, expert-driven, and context-detached assessments. Loss, as Barnett et al. (2016) explain, "arises when people are dispossessed of things that they value, and for which there are no commensurable substitutes" (p. 977). Such a science of loss, drawing heavily from humanities and social science theories and methods, asks what people value in their place-specific contexts, shaped by daily practices and cultures; how climate change and societal changes put these valued things and aspirations at risk; and how losses and suffering can be minimized (ibid). This scholarship builds on understandings of loss regarding personal and collective notions of identity and culture (Morrissey and Oliver-Smith, 2013) and the symbolic, emotional and cultural impacts that matter the most to people within the contexts of their own lives (Adger et al., 2011). Situated approaches are most effective when they are local, able to depict social and cultural contexts, carried out by or with affected populations, and when place-specific and subjective understandings of well-being and harm are taken into account (McShane, 2017). This may be best achieved, as Preston (2017) argues, by paying explicit attention to people's first-voice narratives of loss through which values, needs, feelings, psychological states, and non-substitutability can be explored.

Theoretical advances regarding such a people-focused understanding of loss address the moral and ethical dimensions of whose losses count and how, with wider significance for well-being and security. Preston (2017) cautions against an overemphasis on felt disvalue or embodied negative sensations and their associated psychological harm as people experience them, at the expense of harm to things with intrinsic value, such as nature and species, and ethical losses, arguing that the latter carry significance in themselves. Put differently, "things of intrinsic value could count as loss even if no one is harmed by its loss" (McShane, 2017, p. 126). Moreover, losing the intrinsic value of specific ways of knowing (epistemic loss) can result in loss of epistemic self-determination and, consequently, the ability of communities to deliberate and make joint decisions in accordance to their epistemic practices (Werkheiser, 2017). One's individual sense of self and security can also be corroded through fear and anxiety of feeling or being at risk, even if no actual climate-related harm occurs (Herington, 2017). Yet, identifying when, how, and for whom values essential to such functioning are at risk, damaged, or lost remains methodologically and analytically challenging.

Here, we present the first systematic and comparative analysis of relevant case studies from around the world to make visible the various dimensions of intangible, 'non-economic' damages, risks, and losses as they relate to what people value. Following the recommendation by Serdeczny et al. (2018), we tap into existing studies on climate change-related hazards and impacts on the cultural, symbolic, and affective dimensions of place and culture, being cognizant of the pitfalls outlined above. We ask which of these dimensions of harm, if any, are explicitly or implicitly part of people's lived experiences with climatic hazards, in which contexts and to what extent. In doing so, we seek to 'ground-truth' the intangible loss categories from the scholarly literature, and to show the complexities and nuances of what loss, damage, and being at risk may mean to affected people within the context of their own lives.

2. Data and methods

We adopt a systematic case analysis to assess climate-related intangible damage, risk, and loss reported in the literature. This case analysis allows us to: (1) empirically substantiate relevant categories of harm; (2) make visible patterns of harm across different regions, groups, and climate-stressors; and (3) identify challenges, gaps, and implications for future research to carry out a socially engaged science of loss. Systematic analyses allow for thorough assessment of the state of knowledge in a particular field and have been used in various climate-related areas, including adaptation (e.g. Berrang-Ford et al., 2011; Sherman et al., 2016) and social vulnerability (e.g. Ford and Pearce, 2010; McDowell et al., 2016; Tucker et al., 2015). Being explicit about selection criteria and methods of analysis enhances the transparency and reproducibility of findings while reducing selection bias (Sherman et al., 2016).

2.1. Selection of cases

The selection of appropriate case studies was conducted in two steps. Step 1 established a list of values important in people's lives that are likely to be subject to intangible, 'non-economic' harm related to climate change, drawing from a recent literature review (Tschakert et al., 2017, based on Turner et al., 2008; Fankhauser et al., 2014; Morrissey and Oliver-Smith, 2013; Serdeczny et al., 2016) and tested them for initial usefulness and coding practice across ~30 peer-reviewed case studies identified in the same review. This testing generated 27 value categories (Table 1, left column) that were then used in Step 2 to inform the choice of keywords in the subsequent systematic search of additional cases. This part, performed on Scopus from June to July 2017, identified peer-reviewed journal articles and articles in press from 2000 through to the search date. Only publications in English were considered. Book chapters and reports from governmental and non-governmental organizations were excluded. We first used a search system with tiers of two keywords ["climate change" AND (one of the following) "loss and damage", "intangible loss", "noneconomic loss", "loss", or "damage"], followed by a third tier ("other keyword") with the key words from the 27 values subject to likely harm. This approach yielded 4737 results, which were then systematically screened by the authors to gauge relevance. Cases were excluded if, despite the right key words, they fell beyond the scope of the topic, did not describe in sufficient detail what people consider important in their lives or particular experiences, or were judged to be of inadequate methodological quality. Ultimately, we retained a total of 104 peer-reviewed articles (see –Appendix A), with two articles containing two cases studies, respectively, yielding a total of 106 case studies to be systematically assessed.

While many cases claimed to explore climate change impacts on non-economic values, most examined specific climate stressors (e.g. droughts, floods) without explicitly attributing them to anthropogenic climate forcings. The attribution of specific weather phenomena to anthropogenic climate change constitutes a particularly contentious area of debate, raising questions about climate justice, compensation, and moral repair (see Thompson and Otto, 2015). Although it is beyond the scope of our assessment to make definitive statements regarding attribution, the Intergovernmental Panel on Climate Change (IPCC) (see Bindoff et al., 2013) states that it is 'virtually certain' that anthropogenic forcings have warmed the global climate system, and that such

Table 1
Values important in people's lives likely to be subject to intangible ('non-economic') harm from climate change, based on Tschakert et al. (2017) (left column) and modified for this analysis with some value categories combined to avoid overlap (right column).

Values subject to intangible harm (n=27) (from Tschakert et al. 2017)	Values subject to intangible harm (modified) (n=20) (used in this analysis)
Ability to Solve Problems Collectively	Ability to Solve Problems Collectively
Biodiversity and Species	Biodiversity and Species
Cultural Heritage	Culture, Traditions and Heritage
Culturally Important Landscapes and Sites	Dignity
Culture and Lifestyle	Ecosystem Services
Dignity	Habitat
Ecosystem Services	Human Life
Education	Human Mobility
Emotional and Psychological Distress	Identity
Habitat	Indirect Economic Benefits and Opportunities
Health	Knowledge and Ways of Knowing
Human Life	Mental and Emotional Wellbeing
Human Mobility	Order in the World
Identity	Physical Health
Indigenous and Local Knowledge	Productive Land
Indirect Economic Benefits and Opportunities	Self-determination and Influence
Knowledge and Ways of Thinking	Sense of Place
Order in the World	Social Fabric
Physical and Mental Wellbeing	Sovereignty
Productive Land	Territory
Self-Determination & Influence	
Sense of Place	
Social Bonds & Relations	
Social Cohesion	
Sovereignty	
Territory	
Traditions, Religion & Custom	

forcings have contributed in varying degrees to the range of slow-onset and acute climate-related phenomena considered in this study. We therefore consider the harms assessed here to be reflective of harms associated with anthropogenic climate change, and interpret our findings accordingly.

2.2. Coding and data analysis

Each of the 104 articles was coded separately by two or three reviewers from the author team to enhance the accuracy and validity of the coding process. Differences in coding were discussed for each paper, and for each discrepancy the paper was reassessed and a final judgement reached. Text was rigorously screened for explicit or implicit reference to the selected values, and indications of whether harm to any of these values was to be considered as damage (temporary, reversible), loss (permanent, irreversible, and non-substitutable), and at risk (anticipated future harm) (Thompson and Otto, 2015). The distinction between damage and loss was often inferred from or markedly implied by the place-specific context and reviewers' best judgement rather than explicit discussion in the text, with the exception of loss to life. In the process, a more parsimonious list of values was generated to avoid emerging overlap, resulting in the final 20 values potentially subject to intangible harm shown in Table 1, right column. This is in keeping with the scientific utility of comparative systematic analysis methodology (see Rihoux, 2006). The coding for each case study was compiled into an Excel database, using the binary '1' and '0' to denote, respectively, the presence or absence of a particular value, the degree of harm, the type of climate stressor, the World Bank (2017) country income groupings for the case study nation, the method of data collection, and indigenous versus non-indigenous contexts.

3. Results

Our analysis reveals a large and diffuse body of literature that provides important insight into climate-related intangible harm. Contributions stem predominantly from human geography, anthropology, psychology, rural studies, political science, and ecology. Most of the literature is recent, with almost two-thirds of the articles published from 2013 onwards. A large percentage of the 106 cases studies used interviews as a method of data collection (69%), followed by surveys (40%), one or several participatory, qualitative methods (38%), and focus group discussions (32%), with no discernible differentiation regarding geographic or disciplinary contexts. The majority of case studies used more than one method of data collection.

In the sub-sections following below, we present layers of findings from the analysis of these 106 case studies, showing increasing complexity in the myriad of ways that harm from climate change manifests in people's lives, encompassing rich and poor citizens, rural and urban contexts, and countries in the global South and global North. We start with the distributions of harm caused by eight different types of climate stressors assessed across regions and income groupings (3.1), followed by the various dimensions of intangible harm, with particular emphasis on people's voices and lived experiences shown through examples and direct quotes (Table 3), and Vignette 1 (North American Arctic) (3.2). We complete the presentation of results with three different ways of differentiating between damage, loss, and at-risk sentiments, showing regional distributions, frequencies for values harmed, and a comparison between experiences of indigenous and non-indigenous populations (3.3). To illustrate how a single climate stressor can generate multiple concomitant harms, we examine floods in the UK (Vignette 2). Vignette 3 provides insight into perspectives from high-mountain communities in the Andes, the Himalayas, and the Alps. These vignettes were chosen as they convey multiple types of harm within each context while representing experiences from the global South and global North, as well as from indigenous and non-indigenous populations.

3.1. Uneven distributions of climate-related harm across cultural, socio-economic, and geographic contexts

The 106 cases examined are spread over 47 countries, with harm resulting from one or several of the eight types of climate stressors and climate impacts assessed: floods (47%), droughts (43%), increased temperature and heat waves (42%), storms (29%), sea level rise (22%), glacial melting (10%), reduced sea ice (10%), and bush, forest, and wildfires (8%) (Fig. 1). A noteworthy concentration of case studies is visible for north-east India and Bangladesh, south-eastern Australia, the Arctic, and the high-mountain regions of Peru/Chile/Bolivia and Nepal/Tibet.

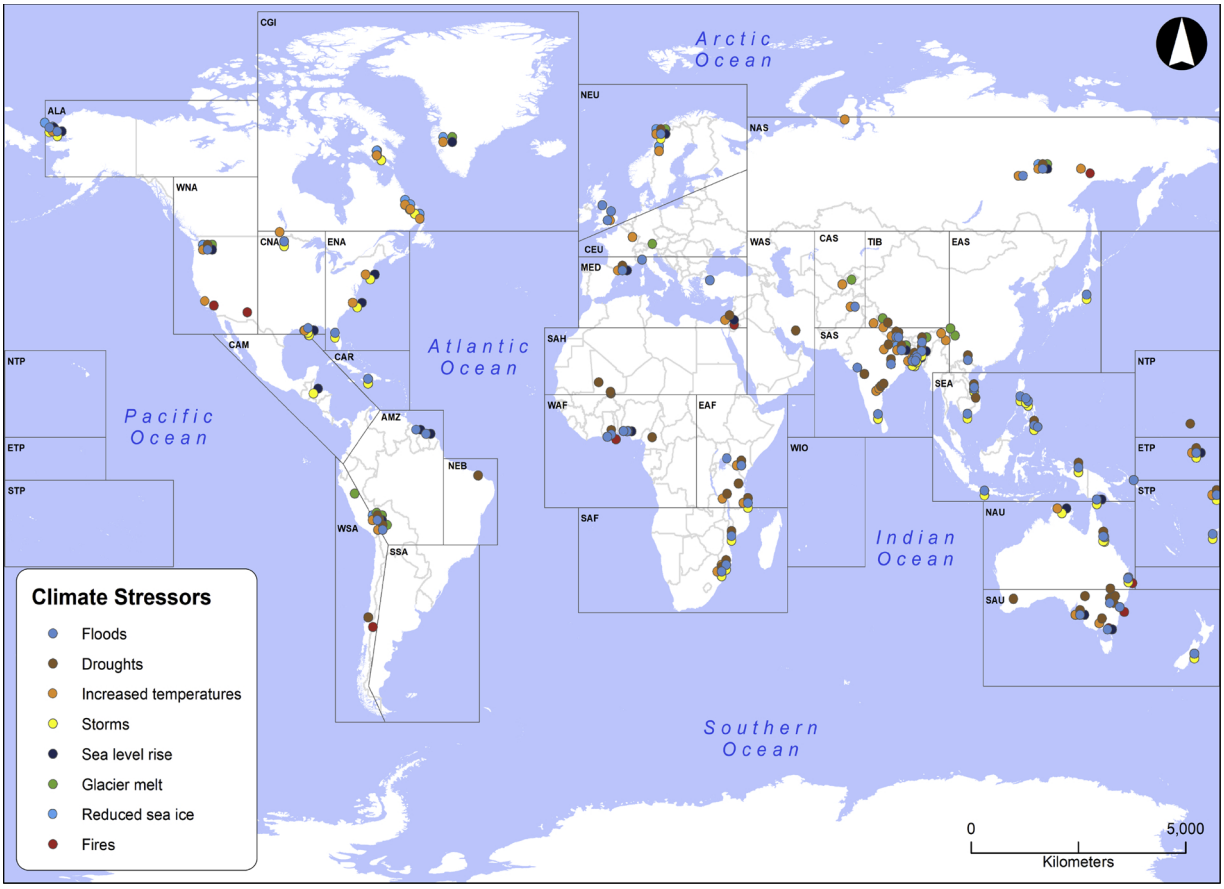

Fig. 1. Geographical distribution of the 106 examined case studies with harm arising from one or more of eight climate stressors or impacts, using the IPCC regions (IPCC, 2015) for orientation.

Frequencies of climate hazards and impacts per income groupings and indigenous/non-indigenous contexts are depicted in Fig. 2. Case studies in low-income countries (LICs), most of them in sub-Saharan Africa, represent only 11% of our entire data set, although vulnerability may be highest. In contrast, the highest proportion of cases stem from high-income countries (HICs), amounting to a total of 40%, with nearly 40% thereof from indigenous contexts (mainly Alaska/North-West Canada [ALA], Canada/Greenland/Iceland [CGI], and the Scandinavian part of North Europe [NEU]). Roughly 34% of all cases are reported for lower-middle income countries (LMICs), with the large majority of them (89%) for non-indigenous populations, many of them in India, Bangladesh, and Vietnam. Those describing indigenous experiences (e.g. from Bolivia, Papua New Guinea, and Cameroon) appear distinctly underrepresented in the literature. The remaining proportions (15%) fall on cases from higher-middle income countries (UMICs), half of them covering non-indigenous settings in China, Iran, Brazil, and Turkey and the other half from Russia, Peru, and some Pacific Small Island Developing States such as Tuvalu.

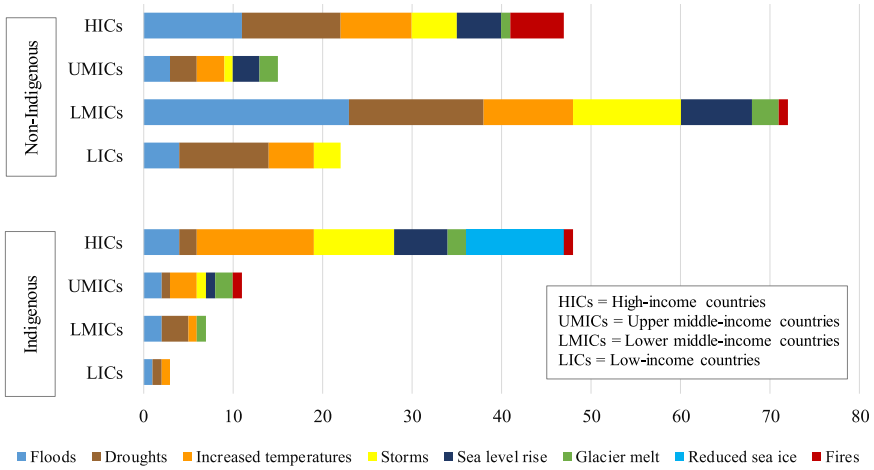

Fig. 2. Climate hazard and impact counts across the 106 case studies, differentiated by indigenous and non-indigenous contexts across the four World Bank country income groupings.

Table 2
Harm counts and percentages across the 106 case studies, for low- (LICs), lower-middle (LMICs), upper-middle (UMICs), and high-income countries (HICs).

Values harmed, across all case studies	LICs		LMICs		UMICs		HICs		Total
	Counts	%	Counts	%	Counts	%	Counts	%	Counts
Culture, Lifestyle, Traditions & Heritage	13	*93*	31	*86*	19	*100*	40	*93*	103
Physical Health	12	*86*	35	*97*	12	*63*	26	*60*	85
Mental and Emotional Wellbeing	3	*21*	22	*61*	15	*79*	41	*95*	81
Human Mobility	9	*64*	30	*83*	12	*63*	27	*63*	78
Indirect Economic Benefits & Opportunities	14	*100*	34	*94*	7	*37*	19	*44*	74
Sense of Place	6	*43*	15	*42*	11	*58*	38	*88*	70
Ecosystem Services	11	*79*	21	*58*	6	*32*	21	*49*	59
Social Fabric	3	*21*	19	*53*	8	*42*	29	*67*	59
Biodiversity & Species	11	*79*	18	*50*	7	*37*	22	*51*	58
Knowledge & Ways of Knowing	7	*50*	24	*67*	5	*26*	19	*44*	55
Productive Land	12	*86*	22	*61*	6	*32*	12	*28*	52
Human Life	3	*21*	28	*78*	5	*26*	14	*33*	50
Identity	0	*0*	6	*17*	7	*37*	25	*58*	38
Habitat	5	*36*	9	*25*	3	*16*	19	*44*	36
Self-Determination & Influence	3	*21*	7	*19*	4	*21*	22	*51*	36
Order in the World	2	*14*	2	*6*	8	*42*	17	*40*	29
Dignity	0	*0*	9	*25*	3	*16*	13	*30*	25
Territory	2	*14*	6	*17*	6	*32*	11	*26*	25
Ability to Solve Problems Collectively	1	*7*	7	*19*	2	*11*	8	*19*	18
Sovereignty	0	*0*	2	*6*	2	*11*	4	*9*	8
Total per country income groupings	117		347		148		427		1039

In terms of occurrence of climate stressors and impacts as discussed in the selected case studies (Fig. 2), floods and droughts are most prominently described in non-indigenous settings, particularly in HICs and LMICs. In comparison, increased temperatures and reduced sea ice are the most often discussed climate-related hazards among Arctic communities in Canada, the United States, and Scandinavian nations, and the former also among Siberia's indigenous groups. Harm occurring from wild fires in our sample is almost exclusively assessed in non-indigenous contexts, primarily in HICs such as Australia.

3.2. The many faces of harm related to climate change

Here, we first provide a quantitative account of the different dimensions of harm across all case studies. As depicted in Table 2, intangible harm has been reported for all 20 dimensions considered important in people's lives. Several dimensions are relevant more or less equally for lower-income countries and higher-income countries. Yet, those that are less prevalent overall (e.g. identity, self-determination and influence, order in the world, and dignity) appear predominantly in case studies from higher-income countries, particularly HICs; in contrast, more attention is devoted to the more tangible domains (e.g. physical health, indirect economic benefits and opportunities, productive land, and human life) in lower-income countries. Taken together, these documented experiences amount to slightly more than one-thousand ways to experience harm.

In order to more effectively lift these real-life experiences from the individual case studies into a more comprehensive account, we first depict their many facets through descriptive examples and first person voices (quotes), adopting Preston's (2017) recommendation to our analysis (Table 3). We caution the reader that several of these narrations are deeply unsettling. We illustrate and hence hope to humanize each of the values subjected to harm from climate-related hazards accordingly, based in descending order reflecting the frequency counts in Table 2. Then, in Vignette 1 (North American Arctic), we illustrate that these various dimensions are seldom harmed in isolation, acknowledging the plurality of ways in which intangible harm is experienced (physically, mentally, and emotionally), as well as how the same value dimension can be harmed by different climate stressors. We present more detail for values that are underrepresented in the literature (e.g. dignity, social fabric, sense of place), to draw attention to the often deeply personal ways in which harm materializes to undermine the material, cultural and spiritual basis of people's lives.

Vignette 1 – the Arctic (North America): Spending time on the land and the sea ice is central to many aspects of Inuit and Inupiat traditional ways of life. However, increased temperatures, precipitating sea ice. and permafrost melt are inhibiting peoples' ability to travel to sacred sites and to engage in traditional hunting and food gathering activities. Loss of life has been reported as consequence of people falling through the thinning ice (Durkalec et al., 2015), while time spent confined in town due to dangerous travel conditions has exacerbated alcohol and drug consumption: "*I find that when you can't get out so much … you tend to do more things. Some people use addictions more, whatever that may be. It may be drinking, or drugging … that's' increasing*" (health worker). Damages to mental and emotional wellbeing are also apparent as people struggle to cope with such confinement "*[…] going out on the land is just as much a part of our life as breathing. Really, we are so close to the land. We are land people. So if we don't get out then, for our mental well-being, it's like taking part of your arm away …"* (Cunsolo Willox et al., 2013, n.p.). Losses to social cohesion and identity also flow from disruption to traditional hunting identities and the social relationships it fosters: *[…] already look at what has happened with people losing that sense of identity and pride and people feel proud of bringing that fish home and that caribou home and they share it with people"* (Inuit Government interviewee) (Harper et al., 2015, n.p.). Such impacts not only magnify current and previous traumas, they have also exacerbated damages to mental health and potential losses to human life via increased prevalence of suicidal ideation: "*a huge increase in the number of clients coming out of the communities for counseling services, now that I can say, a significant increase. So for whatever reason, whether it's related to climate change and them not being able to do things that normally would help their emotional wellness, or whether it's because we've also had a fair bit of death this year…there has been a huge increase* (health professional) (Cunsolo Willox et al., 2013, n.p.).

In some communities, rising sea levels come on top of temperature increases to exacerbate coastal erosion and flooding, forcing people to relocate. In Point Hope, Alaska, the loss of land has generated losses to cultural heritage and traditions, causing an extended sense of trauma as the abandoned homeland remains "anchored in the villagers' souls" (Sakakibara, 2008, p. 471). Losses and damages to residents' spiritual world are also evident as spiritual entities relocate or disappear entirely as a consequence of coastal erosion. Melting permafrost and sea level encroachment are damaging underground ice cellars used for storing whale meat (*siqluaqs*), in turn disrupting sacred relationships between

Table 3
Lived experiences of climate-related, intangible harm across value categories.

	Examples of intangible harm	People's voices about lived experiences with harm
Culture, Lifestyle, Traditions & Heritage: Shared practices, narratives and customs that provide meaning and structure to people's everyday life	Loss of distinct ways of life, practices, objects, memories • Loss of irreplaceable personal possessions in flood, e.g. wedding certificate and craft work (Carroll et al., 2009) • Lack of money for ceremonies among poor households, eroding social fabric and well-being (Udmale et al., 2014)	• Increased temperature and reduced sea ice, Canada, Labrador: *I'm scared that there is not going to be any winter! I'm scared that you are not going to be able to go to your cabins, and the winter cabins people have got…You can't go trapping, like my dad will just lose that altogether. And it scares me that […] you're going to lose your culture even more* (indigenous community member) (Wolf et al., 2013, p557)
Physical health: The contribution of physical health to overall human wellbeing	Physical disability via accident, disease, malnutrition or food insecurity; lack of access to medical care • Skin diseases, malnutrition, limited safe drinking water due to increasing salinity after cyclone (Huq et al., 2015)	• Drought, Iran: *I'm a diabetic. I must not have starchy foods. But you know meat is so expensive and it is impossible not to eat bread, potato and so on. I had to have eye surgery, but I could not afford it, and as a result I lost sight in one of my eyes. The doctors amputated four of my toes last week. I'm terribly sick of it all, and of having to ask God to help me all the time* (woman) (Keshavarz et al., 2013, p125)
Mental and Emotional Well-being: A state of positive well-being contributing to mental health, life satisfaction, coping ability, and overall human well-being	An array of negative emotions (e.g. sadness, worry) and psychological ill-health (e.g. depression, suicidal ideation) • Existential threats, feeling disoriented, lost, and emotionally overwhelmed, deep anxiety and fear of dying during and after cyclones (Woods et al., 2014) • Trauma due to witnessing deaths, hunger, safety risks, contamination, and loss of jobs after floods (Dewan, 2015)	• Drought, Australia: *I was suicidal in January and February. Emotionally the worst period of my life … I feel very isolated … I'm running out of resilience to keep taking the blows and keep moving on … I carry the hurt inside* (man) (Alston and Kent, 2008, p141) • Drought, Iran: *I don't like my children to see me upset because it upsets them. I have gone to the farm and I'll stay there for hours and cry loudly. I'll cry for my son's woes, my daughter's destiny, my husband's hopelessness and my family's poverty. Then I go home and act as if nothing has happened* (woman) (Keshavarz et al., 2013, p125)
Human Mobility: The freedom to remain or travel within one's territory (Fankhauser et al., 2014)	Disruption to established routes and/or means of travel, forced migration, displacement, conflict, ill health • Sexual abuse of women and children in exchange for food in evacuation camps, trafficking (Chandra et al., 2017) • Increased alcohol consumption and violence, inability to travel on reduced sea ice (Cunsolo Willox et al., 2013)	• Cyclone, Bangladesh (forced relocation from rural areas to urban slums): *We now struggle with hunger […] We have to leave our pride behind and beg for help from others. If we had stayed behind on Bhola Island, if I still would have my land and house there, I would be all right today. Our living condition would be better and our children would have ended up being highly educated* (woman) (Ayeb-Karlsson et al., 2016, p690)
Indirect Economic Benefits and Opportunities: Individual income-generating activities and investment benefits for a collective	Income foregone due to disruptive events • Loss of future development opportunities and investment due to coastal erosion (Karlsson et al., 2015) • Increasing threat to tourism industry and property sales due to floods and droughts (Fatorić et al., 2017)	• Coastal floods, Nigeria: *Some women don't have enough stamina to walk the long distance to the Awodikora port which takes about three hours. They [fish processors/ marketers] are not economically productive during this period. Women who are not very tall cannot move through the floods. Sometimes it reaches the neck and even up to the nose* (woman) (Adelekan and Fregene, 2015, p329)
Sense of Place: People's emotional and psychological relationships and attachments to a meaningful place	Homesickness, solastalgia, grief, loss of identity, leading to ill health (Hess et al., 2008; Ellis and Albrecht, 2017) • Loss of home gardens as barriers between inescapable drought and safe home for women (Albrecht et al., 2007) • Lost place attachment, sense of violation of what used to be safe, due to flooding (Tapsell and Tunstall, 2008)	• Wildfire, Australia: *But it's sterile, it's sterile now. The worst thing about - I don't know, everyday it's a different worse thing, but one of the most difficult things about losing everything in a fire, and I guess people lose to house fires all the time, but it totally changed everything about our place, not just the inside, not just the house, not just our stuff, but all our history. Basically it just wiped us, for the last 14 years, off the planet* (man) (Proudley, 2013, p13)
Social Fabric: Social bonds and cohesion between individuals, families, and community members	Poor mental and physical health, isolation and loneliness, fractured sense of community, loss of care for others • Breakdown in traditional game sharing (Lavrillier, 2013) • Loss of relationships and social activities when wives move off-farm to work due to drought (Polain et al., 2011) • 'Hollow homes', figurative and literal 'desiccation' as the thinning out of one's self and body, due to dried-up landscapes and outmigration (Tschakert et al., 2013a) • Less care, indifference, isolation, and family feuds due to drought and water scarcity (Keshavarz et al., 2013)	• Increased temperature, Russia, Siberia: *People's attitudes will get worse and worse, and things will go crazy. People's character is already changing. The way they relate to others has changed, and I think it is because of the climate change. When I was young, Sakha didn't kill each other, and when people beat each other up it was big news. The way people are so violent these days I think is connected to the change in the air and climate* (woman) (Crate, 2008, p580) • Drought, Australia: *Your football teams, your netball teams, your tennis teams, your cricket teams, all - sounds silly - but they all survive on us getting rain… And those sorts of things, people start dropping out of, and there's your community gone* (woman) (Anderson, 2008, p76) • Bushfires, Australia: *I cried everyone [goat]. I had to bury 86 … and I cried every time I picked one up. 'Oh Boy'* (man) (Proudley, 2013, p14)
Ecosystem Services, Biodiversity and Species: The various benefits that people derive from healthy and diverse natural environments and ecosystems	Loss of ecosystem services, animal disappearance/death of animals, fauna and flora previously not known in area • Reindeer dying of new parasitic illnesses and new fly species, due to increased temperatures (Lavrillier, 2013) • Cultural and spiritual services of Ganga River reduced, threatening purifying rituals and identity (Drew, 2013)	• Increased temperature, Mozambique: *Fishing (Bairro) … down in the 1990s … heat gets worse and the fish sanctuaries and homes have all been broken so we only get second grade fish (quality/size) these days* (fisher/ farmer) (Bunce et al., 2010, p420)
	Loss of land for crops and animal husbandry, diminished living spaces for animals (quality, quantity), food	• Increased snow due to warmer winter temperatures, Russia, Siberia: *Then in the fall, the snow falls early and*

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Table 3 (*continued*)

	Examples of intangible harm	People's voices about lived experiences with harm
Productive Land and Habitat: Land and habitat, and their use for agricultural and other activities, contribute to human well-being	insecurity • Cropland and crops washed away and grazing lands submerged by floods, food insecurity (Opondo, 2013) • Saltwater intrusion onto arable riverlands, forcing relocation of agricultural activities (Bunce et al., 2010)	*then it melts and makes a layer of ice under the snow and the horses cannot feed. They can't get through the ice. It also affects them in mid-winter when they have just foaled and they can't find food. This year there was so much snow that lots of animals died, horses especially that could not get through the deep deep snow to find their food. It is warming* (man) (Crate, 2008, p579)
Knowledge and Ways of Knowing: Traditional and local knowledge, and other forms of knowledge specific to particular cultural groups or communities (Turner et al., 2008; Werkheiser, 2017)	Loss of land management skills, cultural rules and practices, and the skills to identify landmarks or species; reduced school attendance • Traditional folklores and folksongs to predict best times for sowing no longer useful (Tripathi and Singh, 2013) • Loss of indigenous oral knowledge due loss of opportunities to access and travel the land due to reduction in sea ice (Harper et al., 2015)	• Temperature increase, Sweden: *And then we realized that so as not to destroy our winter grazing lands we had to leave, although it was only the end of March. And then we said that our father would turn in his grave if he knew that we were on the mountains at this time of year, it would be unthinkable!* (Sami reindeer herder) (Furberg et al., 2011, n.p.) • Drought, Cameroon: *Long ago, I could know when rains started. Nowadays, we have to gamble with the rains. We do not longer know when and what to plant. If you plant early you might lose and if you plant late you might win. We are at a loss of what to do* (Bele et al., 2013, p881)
Human Life: Being alive and living at least as long as the average life expectancy for a given region or population	Human death as a consequence of climate-related disasters (e.g. drowning or heat strokes) or climate stressors entangled with pervasive poverty or anti-poor health policies • Thousands of farmer suicides due to drought and exploitative debt relations (Taylor, 2013) • Thousands of human deaths due to super typhoons (Acosta et al., 2016) • Entrenched poverty and failing harvests due to drought making it impossible to pay for urgent medical interventions (Keshavarz et al., 2013) • Family members and house washed away in flood (Islam et al., 2014)	• Flooding, Nigeria (informal settlement): *Nadia was about six months pregnant when she was urged by her friends to seek obstetric care at the public hospital. When she got there, she was confronted by the 'Compulsory Spousal Blood Donation' (CSBD) policy which requires pregnant women to bring their husband to donate blood before they could register for prenatal care. Nadia's husband, Karim, refused to donate blood on behalf of his wife because he considered blood donation as 'Haram' – a sin against God. Karim offered to pay in lieu of donating his blood but his offer was rejected in the grounds that if everyone paid then the policy is ineffective. Constrained by the inability to meet the blood donation requirement, Nadia was forced to have her baby at home with the help of a midwife. Her delivery day coincided with the July rainstorm, which flooded the Badia community and swept raw sewage, urine, and refuse into Nadia's home, thus contaminating the water ad instruments used during delivery. As a result of exposure to unhygienic and unsafe environmental conditions in the first minutes of life, Nadia's newborn child developed neonatal tetanus infection and died shortly after* (authors' narration) (Ajibade et al., 2013, p1721)
Identity: Attributes or characteristics that define the self-concept of the individual or the group; constituted *inter alia* by membership to a particular social group, cultural practices, and relationships to specific places (Fearon, 1999; Proshansky et al., 1983)	Erosion of personal wellbeing, leading to loss of self-esteem, depression, and suicidal ideation (e.g. Alston and Kent, 2008; Cunsolo Willox et al., 2013) • Eroded self-identity, incompatibility with notions of masculinity and expectations of farmers to be resilient during drought, suicide (Bryant and Garnham, 2015) • Indigenous identity at risk of erasure together with the Tundra and Taiga on which they depend (Lavrillier, 2013) • Drying up of traditional meeting places and hunting grounds (rivers and land) eroding sources of identity and cultural practices, especially for elders (Rigby et al., 2011)	• Increased temperature and reduced sea ice, Canada: *That stuff [unusual season recurring], that to me is taking away our culture, it's taking away our traditional lifestyle, it's taking away our heritage, it's nipping into who we are, ice people, […] people of the snow* (indigenous community member) (Wolf et al., 2013, p557) • Drought, Australia: *I was born here on the farm … I've lived my life here.… In 1917 my grandfather got the farm that I'm on, so it is a family farm, so it is … very, very emotional. For someone to say to me 'why don't you just sell up and get enough dough (money) to buy a nice house somewhere … to grow roses' … well … I might end up getting a gun out and blowing my head off 'cause … just what would I do? I would go insane. So if I lose the farm, it would cost me a marriage … not because she's going to leave me, but because I wouldn't be fit to live with. What am I going to do? I'll go insane. I just can't. I don't even like holidays. I don't even really like fishing* (man) (Ng et al., 2015, p10)
Self-determination and Influence: People's capacity to exert control over their lives, to formulate and pursue desirable futures, and to determine and engage with the epistemic traditions of their community (Turner et al., 2008; Werkheiser 2017)	Loss of agency and independence, leading to erosion of identity, disempowerment, and decision-making power • Feeling of being at the mercy of nature, without any control, during cyclones (Woods et al., 2014) • Feeling of helplessness when familiar places, knowledge, and practices are eroded, lack of control over reduced sea ice and consequences on culture and lifestyle among Arctic communities (Cunsolo Willox et al., 2013)	• Floods, UK: *Every single thing in her life has changed. . . maybe somebody who was in their 30 s or their 40 s, it's a case of 'yes it's been horrendous but we've got new things now, well let's just start a new life.' But when you are 76—she's 77 this year — she got new things and she has no idea — she was only comfortable in her own home because she was comfortable with turning the TV on, the microwave, the oven—she knew in her head. She could control her memory loss because everything was where it had always been, it's not a new thing. Whereas now she cannot turn the TV on and we'll have her ringing up saying, 'I don't know which remote to press. . . I can't remember which drawers, where do I put these?* (woman speaking about her mother-in-law) (Sims et al., 2009, p311)

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Table 3 (*continued*)

	Examples of intangible harm	People's voices about lived experiences with harm
Order in the World: The expectation that life unfolds in a knowable, familiar, and predictable way, including a sense of control and meaning over one's life (Turner et al., 2008)	Confusion, disorientation, and anxiety over a landscape or existence that is no longer recognizable, often unsettling stable identities and social relationships • Feeling the Tibetan Gods' anger and loss of protection from the Gods as a result of melting glaciers, traditional prayers lost their power (Byg and Salick, 2009) • Shifts in the spiritual world, new ritual practices adjusting to dysfunctional environment (Lavrillier, 2013)	• Cyclone, Australia: *The morning after Yasi passed and I looked out over the valley, not only had the valley been stripped naked. I felt naked also …. The helplessness, the joy of everyone being safe, the utter destruction we were looking at and the wondering of how on earth we were to go about doing what had to be done* (woman) (Woods et al., 2014, p5) • Increased temperature and sea level rise, Torres Strait: *We used to read the landscape. But now it changes, you have to guess now … You never know, it just changes like that, even the tide… Like before, you can know what's gonna happen. So hard now, guessing all the time, through* from 2000 *is sort of getting worse … Now everything is changing, even the trees, you can see changes in them, even the fruits, like before, we haven't had mango season* (woman) (McNamara & Westoby, 2011, p 235)
Dignity: The inalienable right of all people to be valued, respected and treated ethically (Shultziner, 2003)	Reduced self-esteem, feelings of shame, disempowerment, and alienation, leading to distress • More alcohol, aggression, anti-social behavior, and shame to Aboriginal culture, due to drought (Rigby et al., 2011) • People no longer feeling human when sharing water with animals during droughts (Tschakert et al., 2013a) • Elderly citizens not asking for help during heatwaves, fearing loss of independence (Abrahamson et al., 2009)	• Cyclone, Australia: *In rural communities you have to look after yourself… you have to be self-reliant - and it is hard to admit that you need a hand. I get very angry and ashamed of myself that I can't protect my wife and home as I used to. I can't climb on the roof anymore, in fact I can't really manage anything that is very physical. It is hard to deal with. I am ashamed of myself* (84-year old man) (Astill and Miller, 2016, p15) • Floods, Kenya: *I moved with my family to the camp …. and stayed there for two months. I did not have money for food and depended on relief from the government and some NGOs….My dependence on other means I lack respect in the community. I am tired of relief aid from the government and NGOs* (woman) (Opondo, 2013, p460)
Territory: The area of land under the jurisdiction of a state, or that belongs to a particular group of people (Fankhauser et al., 2014)	Physical loss of land, or the inability to use land for a specific purpose or livelihood activity • Disappearance of indigenous land due to coastal erosion and thinning sea ice requiring relocation (Shearer, 2012) • Low-lying islands submerged and uninhabitable due to sea level rise, migration (Smith and McNamara, 2015)	• Increased rainfalls, Russia, Siberia: *Every day it is raining. The land is going under water, and the hay lands are smaller and smaller, and if you keep a lot of animals, it is very hard. So tied with the climate change …. The first problem is that the land areas are shrinking, and the second problem is that the quality of the hay is worse. The hay itself has less nutrition, and then when it is cut and lies and gets wet and dries many times, it also loses its nutritional value* (man) (Crate, 2008, p578)
Ability to Solve Problems Collectively: The capacity of a group to participate in collective decision making that affects outcomes relevant to them	Fragmented, unaccountable, exclusive governance structures inhibiting collective problem solving, including the silencing of traditional knowledge • Mismatch between past/resent- and future-oriented world-views undermining indigenous participation in governance, eroding well-being and resilience (Petheram et al., 2015)	• Sea level rise and coastal erosion, Alaska: *[…] the final decision for the rock revetment goes to the [Army] Corps [of Engineers]. We had absolutely no voice for the project. …. The wire baskets, filled with sand, no bottom. One on top of the other, no bottom, and the waves just sucked out the sand from the bottom* (female tribal administrator) (Shearer, 2012, p179)
Sovereignty: The capacity of a group to govern themselves, and the capacity for self-determination (Fankhauser et al., 2014)	Sovereign rights of individuals and populations to make decisions and determine their own futures undermined • Feeling powerless against authorities that devalue pastoral lifestyle and adaptation needs (Furberg et al., 2011) • More pressure on cooperative frameworks among Arctic nations due to sea ice reduction (Hovelsrud et al., 2011)	• Seal level rise, Pacific Islands: *[…] the issue of relocation and resettlement is a very, very serious issue that we are continuing to investigate, but we do not want to leave our land. …. We are not going to go quietly. There are human rights issues; there are sovereign rights issues that need to be looked at carefully* (ambassador) (McNamara and Gibson, 2009, p481)

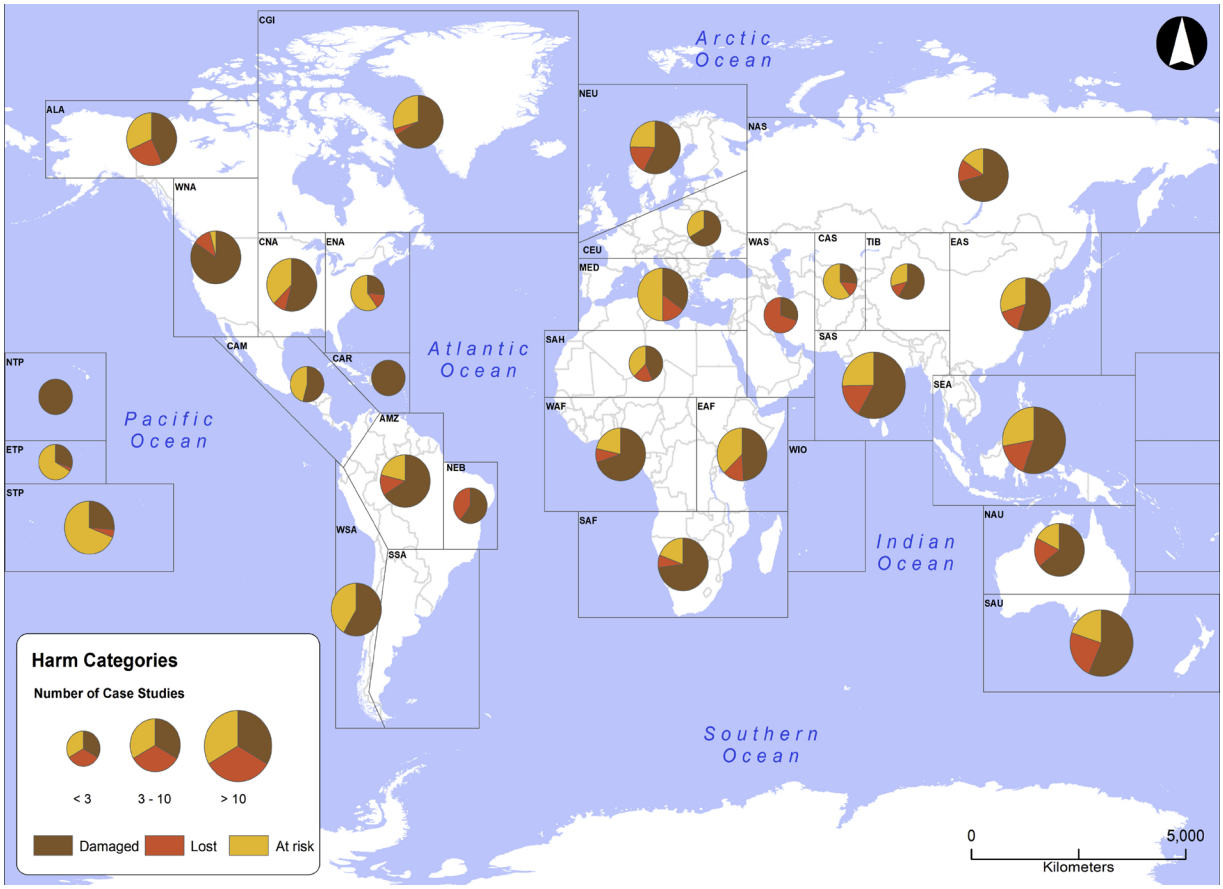

Fig. 3. Geographical distribution of harm experienced, either as damage (brown) or loss (red), and harm anticipated to put people and non-human actors and systems at risk in the future (light orange). The size of the pie reflects the number of case studies assessed per IPCC region.

people, land and whale, and undoing residents' sense of order in the world. Despite cultural reservations to engage with an unknown future (Natcher et al., 2007), some residents expressed anxiety about the prospect of further sea level rise: "*I fear the peninsula will be completely taken [by water] by the time of my great-grandchildren. I fear what will become of where our ancestors are buried. Our cemetery, our memories*" (woman) (Sakakibara, 2008, p. 473).

3.3. Experiencing damage, loss, and feelings of being at-risk

This section of the results presents the last layer of complexity regarding people's experiences with and understandings of climate-related harm, namely whether such harm may be reversible (damage) or irreversible (loss) or whether individuals or entire populations may fear that it would affect them in the future (at-risk sentiments). These distinctions were not always clear cut in the assessed case studies, hence expert judgement from the author team was required (see 2.2 Coding and Analysis).

Damage is observed across the world, and loss and at-risk sentiments are reported in close-to-all regions, with only some few exceptions (Fig. 3). The different size of the pies only reflects available case studies and not the vast evidence of lived experiences of harm. In certain regions (e.g. Northern Europe [NEU], South Asia [SAS], and Southeast Asia [SEA] and Northern and Southern Australia/New Zealand [NAU, SAU], experiences of loss already account for 13–21% of harm from climate-related factors (red-colored segments). Depictions from the Western Asia Region [WAS] signal loss proportions as high as 70%, albeit with a very small number of case studies. Anticipated future harm (yellow-colored segments) is most pronounced (> 60%) in accounts from atolls and islands in the Pacific where coastal erosion and rising seas already threaten food and water security, local livelihoods, and the long-term inhabitability of island communities and states (e.g. Ahlgren et al., 2014; McNamara and Gibson, 2009). The notions of Territory and Sovereignty are seen at risk, not least through the normalization of loss in the media and policy discourses (Barnett, 2017), and with them connections to place, feelings of belonging, family heritage, and culture (see also Table 3). In Funafuti, Tuvalu, for instance, some residents claim to be prepared to '*go down with it*', arguing that "*get[ting] another property and relocate would be to lose our sovereign right and our identity*" (community official) (Mortreux and Barnett, 2009, p. 110–111).

The harm 'heat map' (Fig. 4) illustrates, via individual counts, the pervasiveness of damage, loss, and anticipated risk across all 20 values that we tested as being potentially subject to harm, resultant from all eight climate stressors. The climate stressors and impacts most often discussed in the underlying case studies (floods, droughts, and higher temperatures) also generate the highest number of damages across the large majority of harm categories (dark brown), with counts as high as 50 for Culture, Lifestyle, Traditions & Heritage, and 40 for Social Fabric. More surprising are the numerous counts for losses, with almost all value categories irreversibly affected by each climate stressor, although the maxima are not as high as those for damages. All climate stressors/risks, with the exception of glacier melts and fires (possibly due to the limited number of case studies) show essentially all dimensions of what people value at risk in the future.

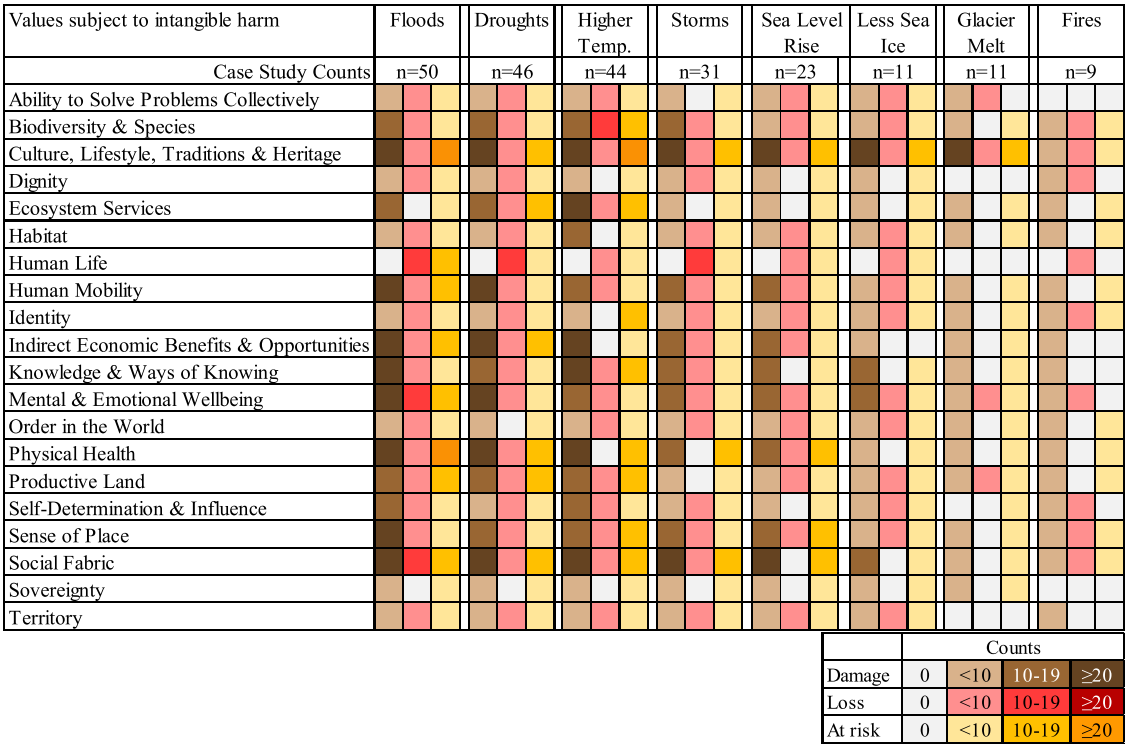

Fig. 4. Frequencies for damages, losses, and at-risk sentiments across the eight climate stressors/impacts and 20 dimensions important in people's lives.

Vignette 2 portrays the embodied experiences of damage, loss, and anticipated harm in the context of flooding in towns in the UK. It shows how a single climate stressor affects multiple values concomitantly, from the perspective of different individuals and their own specific contexts.

Vignette 2 – Floods (UK): The 2005 flooding in Carlisle not only affected thousands of houses but also damaged people's sense of dignity, social relations, mental and emotional well-being, and order in the world (Carroll et al., 2009). Some families shared one hotel room for twelve months while other residents described themselves as 'belonging to nowhere' and 'outcasts' when moved to alternative accommodation. "*They are saying, 'I'll take you for one night.' I had visions of having to carry my belongings round every bloody different night because no one, nobody will take you. I was becoming homeless, there was nowhere else to go*" (woman, displaced for one year) (p. 543). Others still felt like 'squatters' in their own homes, invaded by both the floodwaters and the restoration companies, the latter disrespecting the little sense of dignity and privacy left and shifting the 'locus of control' from what was personal and internal to external and depersonalized. Even more devastating was the loss of personal possessions, such as books, and irreplaceable photographs and marriage certificates. Such destruction erases people's identity: "*I have lost interest in my house … it's not home anymore … I knew that the thing that really finished me (loss of personal possessions and craft work) … because I cannot get my motivation back to do things … I think 'why bother …*" (p. 542). The long recovery process after the 2007 floods in Hull reveals the emotional and material damage to notions of home, ranging from feeling trapped with additional caring responsibilities by taking in displaced family members ("*It's been absolutely horrendous, it's been awful. The whole family has fallen apart so many times since then … the toll it's taken on my family, my husband especially, myself and my children, it's just been horrendous*") to caring arrangements no longer possible due to spatial displacements (Sims et al., 2009, p. 310–311).

Damages to physical health can persist for years after the event, possibly leading to permanent losses. After the 1998 floods in Oxfordshire, initial shock and extreme tiredness ("… *everybody was just so worn out … they had aged at least ten years*") morphed into persistent gastrointestinal illnesses, high blood pressure, respiratory problems, and an array of long-term psychological traumas months and years after the event, particularly for elderly, female, and minority citizens (Tapsell and Tunstall, 2008).

"And [my medication] has increased, I now have to have night sedation, to try and bring the stress down, because it's harming my blood pressure, but I'm stressed now because that water level out there, I'm convinced we're about to get it. It's never going to be any different, it's never going to be any less raw. We're never going to be able to stop having blood pressure pills, night sedation, and all that, that's the life now" (woman) (Tapsell and Tunstall, 2008, p. 144).

In addition to the loss of personal items and the 'loss of intactness of one's life' ("*The house is back to normal but we are not back to normal in the mind*", man, ibid, p.146), the floods triggered a loss of security in place, at home and in one's locale. Some residents now loathe what they had once cherished as their homes have become sites of fear: "*It takes your security away, your confidence in what should be a safe environment. Your home should be a safe, comfortable haven for you but it isn't any more. It's the invasion, the feeling of personal invasion*" (woman). Several continue to be anxious about future risks, acutely aware of their bio-physical vulnerability ("*this awful sense of menacing foreboding … every time there's heavy rain*", "*check[ing] the river … twice or three times a night*", women, ibid, p. 147), coupled with a sense of authoritative failure, both undermining long-term well-being.

Finally, the case studies provided an opportunity to examine similarities and differences in experiences with climate-related damage, loss, and at-risk sentiments between indigenous and non-indigenous populations, whose voices were present in 29% and 71% of assessed accounts, respectively (Fig. 5). Both populations consider all of the 20 values analyzed to be harmed in one way or another, yet the proportions differ. For indigenous groups, the following values had been discussed most often in their accounts as having been imperiled: Culture, Lifestyle, Traditions & Heritage; Sense of Place; Knowledge & Ways of Knowing; Identity; Habitat; Order in the World; Self-Determination & Influence; Territory; and Ability to Solve Problems Collectively. In

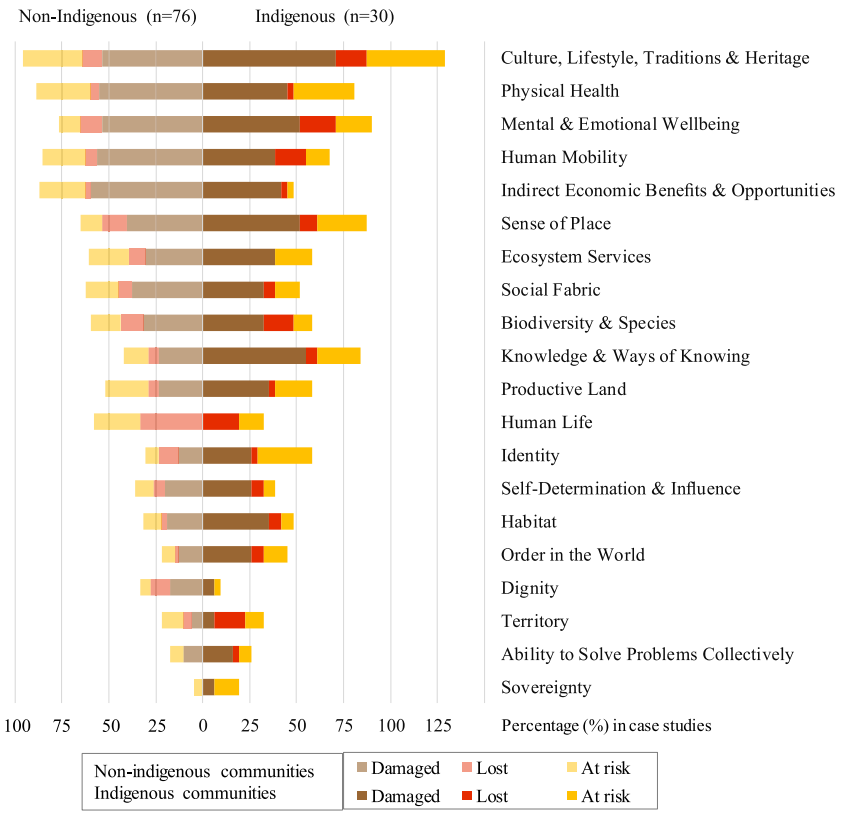

Fig. 5. Experiences of climate-related damage and loss and at-risk sentiments, differentiating between indigenous and non-indigenous populations as extracted from the 106 case studies (in percent).

contrast, for non-indigenous groups, proportionally there is more evidence for harm to Human Life, Indirect Economic Benefits & Opportunities, and Dignity. Vignette 3 provides insights into both worlds through the lens of select high-mountain dwellers in the Andes and the Alps.

Vignette 3 – High Mountain Areas (Andes, Himalayas, and Alps): In the Andes and Himalayas, increased temperatures and glacier melt already cause damage. Indigenous populations report reduced harvests, health problems from eating spoilt food, and a decline in indirect economic opportunities (e.g. tourism) (Baul and McDonald, 2015; Bhattarai et al., 2015; Byg and Salick, 2009; de la Riva et al., 2013; McDowell and Hess, 2012). Moreover, indigenous peoples revere high mountain peaks and glaciers as life-giving deities and the home of powerful Gods (Allison, 2015; Byg and Salick, 2009; Jurt et al., 2015; Shijin and Dahe, 2015). Too much or too little rain and declining glaciers are explained by disrespectful human actions, such as violating local taboos (e.g. taking medicinal plants from sacred sites) (Byg and Salick, 2009) or spiritual pollution (the 'angering of the Gods') which then triggers anxiety (Allison, 2015). Quechua farmers in Peru fear the loss of their agricultural livelihoods as a result of thinning glaciers which they link to contamination by tourists and scientists who install rain gauges ('tubes'); collapsing ice becomes the mountain's (*nevado*) more-than-human response to such adulteration:

"I don't know but this ice has a heart. They say that it grows there, and then they wanted to take it from this "nevado", they took it from the Huascarán – as was told –, they took it with them in tubes. […] Then, back again they wanted to take some from here, but fortunately the lake didn't let them do it. We ourselves took action, there were several who went there for taking and they planted the tubes and wanted to take the heart of the ice with them, sure they know about the nevado's heart. […] Fortunately, the nevado didn't let them, it didn't want and didn't let them enter […], it started collapsing, threatening, […] so they went away […]" (man) (Jurt et al., 2015, p. 519).

Peru's shrinking glaciers have disrupted the spiritual connection between the Quechua and their mountain deities (*Apus*) that no longer wear their 'sparkling white ponchos'; this disruption has triggered social and spiritual alienation and the loss of a centuries-old custom to harvest ice blocks (the holy nectar of the *Apu*) for rituals (Allison, 2015). The reversal of a social hierarchy—from a protective and healing *Apu* to villagers safeguarding the glacial gods with candles and guards—signals a loss of order in the world. A disrupted cosmological order is said to bring tragedy, with not only people's livelihoods but also the glaciers themselves at risk of vanishing, similar to the apocalypse described in Sherpa scriptures in the Nepal Himalaya (Allison, 2015). Women and men in Tibet fear that "*the earth will be destroyed if the snow disappears completely*" and then "*people will disappear from the earth* (Byg and Salick, 2009, p. 165).

The intrinsic power of glaciers is also seen at risk in non-indigenous mountain communities. In the Stilfs-Ortler region of the Italian Alps, people fear further glacial retreat and the associated loss of emotionally and culturally important memories enshrined in battle sites from World War I (Jurt et al., 2015). Stilfs residents are concerned about the disappearing sense of place and unifying identity tied to collective efforts to defeat Mussolini's fascist regime. They also see the damage from tourism, despite economic benefits, experience guilt for being increasingly alienated from nature and doing harm that erodes the glacier's might, and foresee losses for future generations: "*The glacier is simply power, supremacy of nature. Not as it used to be, but… […] Supremacy over human beings. […] It is impressive, not accessible, but particularly for children […] it does not exist in these dimensions anymore. Nowadays, […] I need to walk a bit and then I see a dirty, noisy… something. It is not impressive anymore, and obviously my respect for something like this is low.*" (man) (Jurt et al., 2015, p. 517).

4. Discussion

This systematic, comparative analysis of climate-related loss and damage through the lens of > 100 case studies from across the world, the first of its kind, shows the many layers of harm already being caused by climate stressors. It makes visible the pervasive damages and losses that erode, or obliterate entirely, what is likely important to people in their daily lives, as well as risks that threaten to undermine what has meaning to them into the future. In doing so, our analysis 'ground-truths' the various values identified in the literature as being at risk of climate change-related loss and damage. It shows that losses and damages to all of these values are already occurring, all over the world. This is a wake-up call that not only highlights the moral and ethical contours of loss and the embedded notions of climate injustice (Preston, 2017; Serdeczny et al., 2018), including the urgent support to ramp up adaptation among the most vulnerable populations and ensure compensation for those affected, i.e. ex-ante social transformations and ex-post reparations (Morrissey and Oliver-Smith, 2013). It also puts to rest any aspersions that seek to portray intangible, non-economic losses and damages as random or impenetrable occurrences that distract from what can be more readily measured, quantified, and addressed through top-down policy action guided by nation state interests.

Our results illustrate a myriad of different, real-life encounters with harm that give empirical support to the 'one thousand ways to experience loss' in the title. Some of these are well known in the literature and climate impact discussions (e.g. loss of crops and harvest and resultant food insecurity) while others have been less visible, for instance the break-down of social cohesion or existential threats. Many of these experiences cannot be exclusively tied to climate change (the recurring challenge of attribution) but are entangled with layers of entrenched vulnerabilities as well as other drivers that produce uneven outcomes and future risks. The death of a new-born child in an informal settlement in Lagos, Nigeria, serves as a tragic looking glass through which to witness how a severe rainstorm and coastal flooding coincide with inequities in urban planning and anti-poor health politics to amplify risks for the most disenfranchised (Ajibade et al., 2013).

Yet, our findings also demonstrate that these numerous lived experiences with climate-related harm are unevenly represented in the literature. The largest proportion (40%) of all studies in our sample had been conducted in high-income countries (HICs) compared to only 11% from low-income countries (LICs). Although roughly half of the former address indigenous perspectives, these voices are surprisingly absent in research in middle-income countries (MICs) and LICs. Moreover, the extent to which various dimensions of harm had been addressed in the assessed studies varied markedly. From our analysis, it is clear that more attention has been paid to 'higher order' values important for self-actualization and the pursuit of the 'good life' in HICs compared to values encompassing basic needs and immediate survival in LICs (see Table 2). For instance, Identity is discussed in 58% of studies in HICs but not once in those conducted in LICs, with a very similar pattern observed for Dignity. Even notions such as Sense of Place are reported twice as many times in the former compared to the latter, noting that both Identity and Sense of Place are of particularly high importance to indigenous peoples, especially in the Arctic. In contrast, Indirect Economic Benefits and Opportunities and Productive Land feature distinctly more often in LICs (100% and 86% respectively) than in HICs and upper-middle income countries (UMICs) (around 40% and 30% respectively). Harm to the latter is without doubt easier to assess within standard risk assessment methods whereas the former seemingly constitute 'bonus' dimensions that are more readily incorporated into studies in contexts of relative affluence and/or political significance.

The underrepresentation of Identity, Dignity, and other values potentially considered most 'intangible' in contexts and areas of structural disadvantage is not only a serious limitation of the current literature. It is also indicative of an epistemological injustice (see Fricker, 2007) insofar as current research framings may underrepresent or entirely overlook the more intangible values that people living under such circumstances consider essential in the pursuit of the good life. The epistemological injustice is heightened when considering that persons living in lower-income countries, and particularly under conditions of subsistence, meet a large portion of their needs non-economically (Preston, 2017), and that such nations will bear a grossly disproportional burden of climate risks even under relatively low levels of additional warming (e.g. Harrington et al., 2018; King and Harrington, 2018). Taking our 106 case studies as a reasonably representative sample, we fear that current research efforts significantly underestimate the extent of climate-related, 'non-economic' loss and damage for people living in low-income nations and/or conditions of deprivation. This, in turn, poses a considerable challenge regarding claims for reparation and compensation as the sheer extent of injustice is obscured.

Grounded in this empirical evidence, our findings suggest some challenges, gaps, and ethical dilemmas that would need to be addressed to further advance a socially engaged and situated science of loss, as outlined by Barnett et al. (2016). Such challenges become particularly relevant when considering not only what people value and wish to protect from the negative impacts of climate change, but also the ethics and justice dimensions of individual and collective efforts to navigate and negotiate layers of current and future harm simultaneously and the obstacles that may inhibit such efforts (see Draper and McKinnon, 2018). Contributions from the social sciences and humanities are vital for addressing these challenges and dilemmas.

First, existing technical and quantitative assessment methodologies overlook or are ill equipped to capture many of the intangible values people consider important and subject to climate-related harm. In response, the use of first-voice narratives, as encouraged by Preston (2017), allow people to articulate for themselves how climate-driven harm manifest in their lives, thereby animating the hitherto largely scholarly and technical harm categories. It also substantiates particular things that people value but are subject to intangible harm that so far have been underexplored (i.e. Dignity, Ability to Solve Problems Collectively). The 20 values that we had selected to ground-truth climate-related harm in this comparative analysis are by no means exhaustive; in fact, they are likely to miss out on other aspects and so called 'lived values' in specific contexts and places that people consider fundamental for living a meaningful and dignified life (see Graham et al., 2013). Nonetheless, they offer a helpful and comprehensive frame for starting to build a people-centered loss tapestry that encourages rather than flattens diversity. The rich accounts and their visual translation into the harm 'heat map' (Fig. 4) underscore that these experiences are neither trivial nor sporadic, but rather omnipresent. People's voices and narratives are vital for realizing their livable futures as they create space for agency, deliberation, and co-constructing meaning (Veland et al., 2018) while opening space to grieve and embrace loss (Head, 2016; Cunsolo and Ellis, 2018). Yet, conscious efforts are needed to make visible not only losses that undermine the use value of a specific item or aspect (e.g. indigenous knowledge to predict extreme events) but also other values that tend to get eclipsed when (over)emphasizing embodied experiences (e.g. indigenous knowledge for identity and order in the world) (McShane, 2017).

Second, there are no simple causal relationships between climate stressors and intangible loss and damage; rather, the relationship between climate and harm is mediated by personal circumstance, culture, and socio-economic context. This is precisely why caution is required when investigating loss through the lens of comprehensive risk assessments (see Roberts and Pelling, 2018) as such approaches tend to be reductive in design, often based on metrics too narrow to encapsulate these context-specific nuances, particularly when applied in comparative analyses (Adger et al., 2018). The Vignettes show that the same climate hazard or impact is often interpreted differently between individuals (e.g. in flood-affected households in the UK) and cultural groups (e.g. in high-mountain areas), thus generating diverse and concomitant experiences of harm within and between communities.

Moreover, such experiences rarely occur in isolation from one another, meaning that affected individuals and groups have to contend with a complex bundle of economic and less tangible damages, losses, and fears of future risks that can easily overwhelm people's ability to cope (e.g. damaged or lost possessions, deteriorating health conditions, panic attacks, loss of control, strained family relations, and the very personal heartbreaks about shattered meanings and sense of belonging). Ultimately, what may be considered an acceptable harm to some might well constitute an intolerable loss to others. Without explicit attention to the complexity of the simultaneous and consecutive threats that people experience, and anticipate, it is exceedingly difficult to draw meaningful conclusions about how, when, where, and for whom livelihoods and lifestyles are disrupted, how past traumas are amplified, or prospects of leading dignified lives eroded.

Third, it is exceedingly difficult to disentangle damages, losses, and anticipated risks, not only in case studies designed without such an explicit goal, but also our own uncertain worlds. This challenge was evident in some of the Arctic and Small Island examples where the likelihood of further climatic changes (i.e. temperature increase and sea level rise) presents an existential threat to the long-term habitability of residents' homelands, hence constituting a loss in and of itself. Although feeling at risk may trigger adaptive action (e.g. Ford et al., 2015), Herington (2017) argues that mere feeling of being at risk, even if no harm occurs, undermines a sense of personal security in the future and with it possibly capacities to plan, prepare, and protect, hence further amplifying negative outcomes for well-being. Retaining a strong sense of individual and collective self to solve problems collectively and influence future outcomes is essential when decisions about possible actions to reduce risks are negotiated, also involving future generations. The case studies set in indigenous or tribal contexts illustrate that, in order to flourish as a group, a 'collective continuance' is needed in which past, present, and future coexist (Whyte, 2016) or, as framed by Gendreau (2017), a distinct individual and collective agential functioning rooted in a strong sense of self and identity. Identifying the subtle yet nontrivial shifts from individual to community losses, and associated justice ramifications, is not only a challenge in policy debates about compensation; it is also a challenge for rigorous diagnostic scholarship, for instance regarding climate-induced relocation (Draper and McKinnon, 2018).

5. Recommendations and conclusion

Translating these insights into rigorous empirical research that advances a socially engaged science of loss forces critical reflection upon the methods and methodologies best suited to investigate, in situ, what people value in their daily lives, what they see at risk from climate change (both in tangible and intangible terms), and how to best engage with unavoidable loss. To overcome epistemological biases and their attendant injustices, a co-production of knowledge with affected communities is a prerequisite, ideally employing participatory, democratic, and qualitative methods, centered on careful and caring listening and with an appreciative eye for non-human entities (McShane, 2017; Preston, 2017). As Veland et al. (2018) argue, engaging people through their own narratives, deliberations, and visions allows protagonists to make sense of observations while also "story[ing] safe and desirable pathways away from dangerous and unjust outcomes, and toward dignified futures" (p44). Methodologically, it is imperative to allow sufficient space and time for research participants and partners to come to terms with their entangled experiences with loss and harm, acknowledging the need to gently work through the erosion of both life certainties and people's capacity to act (Alston et al., 2018).

From a conceptual perspective, such research will need to move beyond the rather static snapshots of harm as provided in most case studies assessed here. Past examples in the literature (e.g. Huq et al., 2015; Sallu et al., 2010) demonstrate how to capture cumulative encounters with stressors and harm, even at the household level, and hence mirror advances in scholarship on vulnerability dynamics (e.g., Tschakert et al., 2013b; Fawcett et al., 2017). Equally important is a better understanding of which types of harm are acceptable or intolerable, to whom and why, and how people negotiate the many value trade-offs in attempts to preserve what they deem most precious and worthy of preservation (Preston, 2017; Tschakert et al., 2017). Such attention to trade-offs has started to emerge in climate-related loss scholarship (e.g. Fincher et al., 2014; Karlsson et al., 2015); yet more explicit attention to power and authority in deliberations is recommended (Preston, 2017), including what is considered acceptable loss and who decides, as well as how to diffuse harm before it becomes intolerable. Finally, and perhaps methodologically most challenging, is to examine how trade-offs may change with new information on likely future climate realities—e.g. prospects of up to 8 °C higher night temperatures in the Arctic by 2100 (Seneviratne et al., 2018)—without precipitating a psychological paralysis by merely imagining the risk.

We are optimistic that methodological ingenuity and commitment to engaging with place 'from within', for instance through political listening (Bickford, 1996), arts-based community workshops, and deliberative future mapping, can create the needed space to collectively examine and combat damages while exploring curative ways to embrace and cope with unavoidable loss. A socially engaged science of loss is inherently 'slow research' (Adams et al., 2014). It resists policy makers' requests for rapid risk analysis tool-kits while fostering situated agency and anticipatory planning, preventing risks turning into losses, and navigating climate-related harm, without succumbing to the urge to quantify and prioritize.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.gloenvcha.2018.11.006.

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